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INTRODUCTION.

This REVIEW treats generally the meteorological conditions of the United States and Canada for June, 1889, and is based upon reports of regular and voluntary observers of both countries.

On chart i the paths of the centres of ten areas of low pressure are shown; the average number traced for June during the last fifteen years being 9.2. This chart also exhibits the paths of the centres of five depressions traced over the north Atlantic Ocean; the limits of fog-belts west of the fortieth meridian, and the distribution of icebergs and field ice during the month. The areas of high and low pressure and north Atlantic storms are discussed under their respective headings.

Chart ii exhibits the distribution of mean atmospheric pressure and temperature for the month. The mean temperature was below the normal over a greater part of the interior and southern parts of the country; and at a large number of stations in the south Atlantic and east Gulf states, and in the Ohio and upper Mississippi valleys the lowest absolute temperature noted during the periods of observation was reported. At several stations, with short records, on the Pacific coast north of the fortieth parallel, the maximum temperature was higher than previously recorded for June.

Chart iii shows the distribution of precipitation for June, 1889. More than the average amount of precipitation for the month fell from New England and the lower lakes southward to the Gulf of Mexico, and thence westward to the Rio Grande Valley and the middle-eastern slope of the Rocky Mountains; elsewhere the precipitation was deficient, and from Minnesota westward to the Pacific coast, and over the middle plateau region, averaged less than one-half the usual amount for June. The greatest excess occurred in the south Atlantic states, where the rainfall exceeded the June average by about 50 per cent.

The destructive floods at the beginning of the month in sections of the Middle States are discussed in this and the preceding issue of the REVIEW.

Under the heading "Drought" are given extracts from reports of observers in Dakota, Montana, and Idaho relative to the damaging drought that prevailed in those territories.

In the preparation of this REVIEW data from 2,226 stations have been used, classified as follows: 175 Signal Service stations; 124 monthly registers from United States Army post surgeons; 1,412 monthly registers from state weather service and voluntary observers; 22 Canadian stations; 164 stations through the Central Pacific Railway Company; 329 marine reports through the co-operation of the Hydrographic Office, United States Navy; marine reports through the "New York Herald Weather Service;" monthly weather reports from the local weather services of Alabama, Arkansas, Colorado, Illinois, Indiana, Iowa (Weather Crop Bulletin Service), Kansas, Kentucky, Louisiana, Michigan, Minnesota, Mississippi, Missouri, Nebraska, Nevada, New England, New Jersey, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, and Texas, and international simultaneous observations. Trustworthy newspaper extracts and special reports have also been used.

ATMOSPHERIC PRESSURE (expressed in inches and hundredths).

The distribution of mean atmospheric pressure for June, 1889, as determined from observations taken daily at 8 a. m. and 8 p. m. (75th meridian time), is shown on chart ii by isobars. The difference between the mean pressure for June, 1888, obtained from observations taken twice daily at the hours named and that determined from hourly observations varied at the stations named below is as follows: At Washington, D. C., New York, N. Y., and Boston, Mass., the mean of the 8 a. m. and 8 p. m. observations was higher by .005, .006, and .012, respectively, while at Saint Louis, Mo., Chicago, Ill., and San Francisco, Cal., the mean of the observations taken at these hours was .001, .002, and .014, respectively, lower than the true mean pressure.

The mean pressure for June, 1889, was highest on the North Carolina coast, where it rose to 30.11 at Hatteras. From the southern New England coast southwestward to the eastern Gulf coast and along the coast of Washington Territory the mean readings rose to or above 30.05. The mean pressure was lowest within an area extending from the lower valley of the Colorado River west of north over southeastern California, where it fell to 29.76 and 29.75 at Yuma, Ariz., and Keeler, Cal., respectively. From this region a trough of low mean pressure extended east of north over the plateau and Rocky Mountain regions to the Canadian Northwest Territories within which the values varied from 29.80 to 29.90. The mean readings were below 29.90 in the lower Saint Lawrence valley, and fell below 29.95 north of the forty-fifth parallel except on the Pacific coast, and in the Rocky Mountain and plateau regions save over a portion of the middle eastern slope.

Compared with the pressure chart for May, 1889, an increase in pressure is shown, except in the Gulf states, the upper Missouri valley, over portions of the middle and southern plateau regions, and on the middle and south Pacific coast. The most marked increase in pressure has occurred on the North Carolina coast, where it amounts to .10, and the greatest decrease, about .10, in the San Joaquin Valley, California. In May, 1889, no well-defined area of high pressure was shown and the mean pressure was highest along the east Gulf coast and over Florida. In the current month the isobar of 30.10, traced on the North Carolina coast, and the isobar of 30.05, traced on the coast of Washington Territory, indicate the regions of highest pressure over the eastern and western portions of the country. From the Colorado Valley northward to the British Possessions north of Montana and Dakota there has been a slight decrease in pressure within the trough of low mean barometer which covered that region.

Compared with the normal pressure for May the mean pressure was above the normal except along the west Gulf coast, in the Rio Grande Valley, eastern Wisconsin, Manitoba, and from the valley of the Columbia River southward along the Pacific coast. The greatest departures above the normal occurred at stations on the New England and south Atlantic coasts, and within an area extending from northern Texas northwestward over Colorado, where they were more than .05. In sections where the mean pressure was below the normal the departures were small, except on the middle Pacific coast, where they were more than .05.

BAROMETRIC RANGES.

The monthly barometric ranges at the several Signal Service stations are given in the table of miscellaneous meteorological data. The general rule, to which the monthly barometric ranges over the United States are found to conform, is that they increase with the latitude and decrease slightly, though somewhat irregularly, with increasing longitude. In June, 1889, the ranges were greatest over eastern and northern New England, where they were more than .90, and least over southern Florida, southern Arizona, and along the California coast, where they were less than .30. In this month the barometric ranges uniformly increased with the latitude (except in the central valleys, where they were greatest in the lower Missouri valley, whence they decreased slightly northward,) and decreased with a fair degree of regularity with increasing longitude. Along the Atlantic coast the ranges varied from .22 at Key West, Fla., to .93 at Manchester, N. H., Portland and Eastport, Me.; between the eighty-second and ninety-second meridians, .34 at Mobile, Ala., to .84 at Alpena, Mich.; between the Mississippi River and the Rocky Mountains, .31 at Galveston, Tex., to .85 at Leavenworth, Kans.; in the plateau and Rocky Mountain regions, .24 at Whipple Barracks (Prescott), Ariz., to .72 at Fort Custer, Mont.; on the Pacific coast, .21 at San Diego and Los Angeles, Cal., to .65 at Fort Canby, Wash.

AREAS OF HIGH PRESSURE.

Six well-marked areas of high pressure appeared within or near the limits of stations of observation during the month of June, three of which crossed the continent from or near the north Pacific coast to the Atlantic coast, moving southeasterly while the centre remained west of the Mississippi, and afterwards almost directly towards the eastward. Two originated over the Pacific to the west of California and moved northward along the coast to near the fiftieth parallel; of these, one remained central on the Pacific coast at the close of the month, while the other crossed the Rocky Mountains and was traced eastward to the south Atlantic coast. One area appeared north of Montana and disappeared after moving southward to Minnesota. This was followed two days later by an area of high pressure which appeared north of the Lake region, apparently moving eastward, and it disappeared to the east of Nova Scotia.

The following table exhibits in a concise manner some of the more prominent characteristics of the high areas:

No.	First observed.			Last observed.		Duration.	Velocity per hr.	Highest pressure.			
	Date.	Lat. N.	Long. W.	Lat. N.	Long. W.			Date.	Station.	Reading.	
		°	°	°	°	*Days.*	*Miles.*			*Inches.*	
I	1	50	119	32	75	8.0	18	10	Hatteras, N.C.	30.28	
II	8	52	115	33	74	8.0	31*	10	Cheyenne, Wyo.	30.38	
III	13	52	117	45	96	2.0	25	14	Assiniboine, Mont.	30.26	
IV	17	49	85	44	59	2.0	31	19	Halifax, N.S.	30.16	
V	15	40	128	40	67	11.5	15	24	Toronto, Ont.	30.50	
VI	28	40	127	47	126	2.5	12†	30	Fort Canby, Wash.	30.24	
Mean.						5.7	22.0			30.30	

*This area moved 31 miles per hour while passing over the continent, but it remained stationary several days near the south Atlantic coast. †Northerly movement.

I.—On the first of the month the pressure was high over Oregon, while areas of low pressure covered the region north of Dakota, the southern plateau and southern Rocky Mountain regions, and a storm of considerable energy, attended by heavy rains, prevailed over the Lake region and middle Atlantic states. The area of high pressure moved slowly to the southeastward to the central Rocky Mountain regions between the 1st and the 4th, the pressure decreasing at the centre, but the flow of air from the north was sufficient to replace the slight depression which existed over Texas on the 3d. It apparently passed eastward over the southern portion of the continent, reaching the south Atlantic states on the 7th, attended by a slight increase of pressure. It was most marked as central off the south Atlantic coast on the 8th, where it remained until re-enforced by the succeeding area of high pressure.

II.—Was first observed in the region northwest of Montana on the 8th, and passed southeastward, following the same general course as that described for high area number i, although its movement was more rapid and it was more clearly defined during its transit over the Mississippi Valley. It passed over the Rocky Mountain regions on the 10th, attended by killing frosts, and over the Mississippi Valley on the 11th, apparently uniting with the area of high pressure which had remained almost stationary off the south Atlantic coast from the 8th to the 12th. This general distribution of pressure continued until the 17th, the high areas covering the greater portions of the country east of the Mississippi. During the 17th the pressure on the Atlantic coast declined rapidly owing to the advance of a tropical storm from the east Gulf which followed the general course of the Gulf stream.

III.—This area was first observed in the same locality as that described for areas numbers i and ii. When it appeared on the 13th an extended area of low pressure covered the greater portion of the plateau and Rocky Mountain regions. It moved southward over Montana, where it was central on the 14th, dividing the area of low pressure previously referred to, apparently forcing a minor disturbance to the eastward over the Lake region, while the principal area of low pressure was driven to the westward over the plateau region. The pressure attending this area of high pressure decreased as the centre approached the upper Mississippi valley, where it was last traced as a separate area.

IV.—Appeared north of the upper lake region on the 17th, following closely to the westward a disturbance which passed over the Maritime Provinces on the 16th. It moved directly eastward during the 17th and 18th north of, and slightly in advance of, a tropical storm traced as number vii on chart number i.

V.—Reports from the Pacific coast on the 15th indicated the advance of an area of high pressure from the Pacific. The succeeding reports from the 15th to the 20th exhibited a general movement of this area of high pressure to the northeastward, attended by a general increase of pressure over the northern plateau and Rocky Mountain regions, the pressure remaining below the normal to the southward. During the 20th the direction of movement changed to the southeast, and by the morning of the 21st this area covered the entire region from the Rocky Mountains eastward to the Lake region, the centre being in western Kansas. It passed directly eastward, attended by increasing pressure as it approached the coast, and extending from the Gulf northward to British America. It passed off the coast on the 25th, but reports indicate that it moved slowly and that it had a controlling influence on the weather in the Atlantic coast districts until the close of the month, the barometer continuing above the normal from Nova Scotia southward to Georgia.

VI.—Appeared on the Pacific coast on the 28th, and apparently moved northward to Washington Territory, where it was central at the close of the month. The 8 p. m. telegraphic report of the 30th exhibited two well-marked areas of high pressure, one apparently central northeast of New England and extending over the eastern half of the continent, while the other covered the Pacific coast, and an extended trough of

low pressure covered the Rocky Mountain regions, the barometer being unusually low in Montana.

AREAS OF LOW PRESSURE.

Ten well-defined areas of low pressure were observed during the month of June, only one of which passed over the Atlantic within the limits of the coast of the United States, and none of which were traced over the continent south of the thirty-eighth parallel of latitude. These disturbances generally had their origin or were first observed in the regions north of Montana. While no area of low pressure has been traced directly from the Pacific coast, three disturbances were first observed in the Rocky Mountain regions attended by conditions which indicated that they had their origin over the plateau regions or further to the westward. The general course of the low areas observed was to the eastward, while west of the Mississippi, and afterwards to the north of east. An examination of chart number i will show that the centre of no disturbance passed over the continent between the lower lake region and the Gulf coast.

The following table exhibits the principal parts regarding these low areas:

No.	First observed.			Last observed.		Duration.	Velocity per hr.	Lowest pressure.		
	Date.	Lat. N.	Long. W.	Lat. N.	Long. W.			Date.	Station.	Reading.
		°	°	°	°	*Days.*	*Miles.*			*Inches.*
I	2	42	90	48	64	2.5	25.0	5	Chatham, N. B	29.48
II	5	42	73	49	67	2.0	13.5	6	Eastport, Me	29.42
III	4	51	112	45	80	5.0	26.0	4	Calgarry, N. W. T	29.24
IV	10	52	110	50	60	3.0	33.0	10	Medicine Hat, N. W. T.	29.50
V	12	46	114	49	65	3.0	36.0	13	Fort Sully, Dak	29.68
VI	16	52	114	47	57	5.0	27.0	20	Anticosti, Gulf of St. L.	29.34
VII	15	20	85	37	74	4.0	20.0	18	Near Charleston, S. C.	29.53
VIII	19	38	105	50	60	3.5	32.0	21	Quebec, Quebec	29.56
IX	25	52	118	54	102	3.0	15.0	28	Qu'Appelle, N. W. T	29.26
X	29	54	114	52	107	1.5	7.0	31	Medicine Hat, N. W. T.	29.40
Means						3.2	23.4			29.44

I and II.—The storm which extended over the eastern portion of the United States on the 1st of the month has been traced on the charts accompanying the previous REVIEW. This storm remained central north of the Lake region until the 2d, attended by a secondary disturbance which moved northeastward over the middle Atlantic states to New England where it disappeared. The principal disturbance was followed by the low area traced as number i which was first observed as central in southern Wisconsin on the afternoon of the 2d. It passed northeastward over the upper lake region, attended by slight energy, and becoming more extended during its easterly movement. On the morning of the 4th it was central north of Lake Huron, but the bounding isobars indicated minor disturbances to the southeastward over New England and the middle Atlantic states. On the afternoon of the 4th the centre had advanced to northern New England, and during the following night a northeasterly movement was observed, both of the principal disturbance and the minor depressure which developed in southern New England and which has been traced as low area number ii. Number i disappeared to the northeast during the 5th, while number ii moved northeastward during the 5th and 6th and disappeared to the north of the Maritime stations on the 7th.

No. III.—This area of low pressure was observed north of Montana on the 4th and moved directly eastward during the 5th and 6th, the attending trough of low pressure extending southward over the eastern slope of the Rocky Mountains, while the principal disturbance apparently remained north of Minnesota. During the 6th the minor disturbance developed over Minnesota, while there are indications of other disturbances to the southwestward. The morning report of the 7th exhibited two well-marked areas of low pressure, one to the north of Lake Superior and the other central in the Missouri Valley. The latter moved southward during the 7th to southern Kansas, after which its course changed to the northeast and it passed rapidly over the Lake region as a well-marked area of low pressure, the barometric pressure increasing, however, during the easterly movement, the storm attaining its maximum energy during its passage over the central Mississippi valley and Lake Michigan. The increasing pressure at the centre was so rapid as to make it impossible to trace this storm to the east of the Lake region, and the indications are that it did not reach the coast.

IV.—This storm also originated within the region north of Montana. It was a minor disturbance which was first observed on the 10th, and it was at no time central within the limits of the United States; its movements eastward, however, have been traced from the regular telegraphic reports from the 10th to the 13th, on which last date it was passing eastward over the Maritime Provinces. In tracing this storm the location of the centre at each of the telegraphic reports could be given only approximately owing to the high latitude of its course.

V.—This disturbance was observed in Idaho on the 12th, and was apparently forced to the southeastward by the advance of an area of high pressure from the north, which, as previously stated, divided this low area and forced the eastern secondary disturbance to the eastward over the Lake region during the 13th and 14th. Although the movements of this disturbance can be clearly traced from the telegraphic reports, it was attended by no marked change in the weather conditions, owing to its slight barometric gradient and the increasing pressure during its easterly movement while passing over the Lake region. After the centre reached the lower Saint Lawrence valley the wind shifted to westerly in New England and on the middle Atlantic coast, attended by local storms, the wind reaching a maximum velocity of thirty-four miles at Block Island.

VI.—This storm appeared north of Montana on the 15th, and apparently approached that region from the north. It moved eastward and developed energy north of the stations of observation during the 16th, 17th, and 18th, when it was central north of Manitoba. During this movement to the eastward a secondary depression developed in the southern portion of the barometric trough which extended over the Rocky Mountain regions. This minor disturbance moved rapidly eastward, covering the northern and eastern slope of the Rocky Mountains on the 18th, attended by severe local storms, and apparently united with the principal depression to the north of Lake Superior on the 19th. After the union of these disturbances, the principal disturbance moved eastward, crossing the lower Saint Lawrence valley as a storm of considerable energy on the 20th. The minimum pressure observed within this disturbance occurred at Anticosti, Gulf of Saint Lawrence, on the evening of the 20th, when the barometer fell to 29.34. Brisk to high westerly winds continued over the Gulf of Saint Lawrence on the 21st, during which date this storm apparently disappeared to the northeast.

VII.—This is the only well-marked tropical storm observed during the month; while the reports from land stations do not indicate the existence of this storm before the 17th, the marine reports show that a storm was central in the east Gulf, to the west of Cuba, on the 15th and 16th. By the morning of the 17th it had reached the west Florida coast, attended by heavy rains and high easterly winds. It passed to the northeast over northern Florida during the 17th, causing a maximum wind of forty-three miles per hour at Cedar Keys, and a wind of thirty-four miles per hour at Jupiter. It continued its northeast course during the 18th along the south Atlantic coast, attended by severe gales, the wind at Charleston reaching thirty-four miles from the east. On the 19th it was apparently central to the east of the middle Atlantic coast, causing a wind of thirty-six miles from the east to northeast at Block Island. During the 19th it continued its northeasterly course, and it is probable that it united with low area number vi after that disturbance reached the lower Saint Lawrence valley.

VIII.—Developed over Colorado during the 19th, the pressure being low during the previous day over the central plateau

region. This disturbance was a limited area and moved rapidly eastward over the Missouri and central Mississippi valleys, attended by light rains. It declined to the northeast after passing over the Lake region, the pressure decreasing at the centre, the disturbance becoming much more extended as it approached the Saint Lawrence Valley. It continued its northeasterly course during the 22d and 23d, followed by an area of high pressure which caused rapid increase in the barometric gradient in the southwest quadrant, and this was attended by strong southwesterly gales in the Saint Lawrence Valley.

IX and X.—These disturbances appeared in the region north of Montana, the former on the 25th and the latter on the 29th. Neither of these storms caused any marked change in the weather conditions in the regions east of the Mississippi during the month. Previous to the development of the storm traced as number ix, a disturbance appeared in the same locality on the 22d. The barometer fell to 29.12 at Swift Current, N. W. T., on the afternoon of the 22d, and at that date the indications were that the most severe storm of the month was slowly advancing eastward from the region north of Montana. A change in the direction of movement, however, carried this disturbance to the northeast before reaching Manitoba, and the centre of the disturbance could be only approximately located at three regular telegraphic reports, and it has therefore not been traced as an area of low pressure on chart i.

NORTH ATLANTIC STORMS FOR JUNE, 1889 (pressure in inches and millimetres; wind-force by Beaufort scale).

The paths of the depressions that appeared over the north Atlantic Ocean during June, 1889, are shown on chart i. These paths have been determined from international simultaneous observations by captains of ocean steamships and sailing vessels received through the co-operation of the Hydrographic Office, Navy Department, and the "New York Herald Weather Service."

Five depressions have been traced for June, 1889; the average number traced for the corresponding month of the last six years being eight. Of the depressions traced for the current month, three were continuations of areas of low pressure which first appeared over the North American continent; one prevailed west of the British Isles during the earlier days of the month; and one first appeared north of the Bahamas. The West Indian hurricane which advanced northward from the Caribbean Sea during the second decade of the month is described as low area vii. Along the trans-Atlantic steamship tracks west of the Banks of Newfoundland unsettled weather, with moderate to fresh gales, prevailed from the 4th to 7th, 13th, 14th, 17th, and 20th to 23d, attending the passage of depressions to the northward. From the 15th to 19th a depression of moderate strength moved northward from the west portion of the Caribbean Sea over the eastern part of the Gulf of Mexico and thence northeastward off the coast of the United States, attended by fresh gales, save on the 18th, when central off the south Atlantic coast, when strong gales were reported. During the 24th and 25th fresh gales prevailed off the south Atlantic coast with the passage of a depression which apparently advanced from the north of the Bahamas and dissipated over the south Atlantic states. Over mid-ocean the month was characterized by low barometric pressure north of the trans-Atlantic steamship routes during a greater portion of the second and third decades, while south of the forty-fifth parallel the pressure continued generally high. These conditions occasioned fresh westerly winds along the steamship routes during the periods referred to. Over the eastern part of the ocean fair weather prevailed, except during a portion of the first decade. From the 1st to 4th a depression of considerable strength, with pressure falling to about 29.00 (736), was central west of the British Isles, attended by fresh to strong gales, which increased in force to whole gales on the 4th. From the 8th to 10th fresh north to west gales were reported south and east of the British Isles, attending the presence of a depression to the eastward.

The general character of the weather over the western part of the Caribbean Sea is indicated by the following report of Capt. Geo. S. Locke, commanding the steamship "Muriel": "The weather during June, 1889, in the Caribbean Sea, and particularly at the Windward Islands, has been unusually stormy, with extraordinary rainfall. On the Island of Dominica, on 'Shawford Estate,' the rainfall was 28.54 inches for eight consecutive days, with frequent squalls of hurricane violence. The total rainfall on the Island of Dominica for the month was 44.36 inches, and many of the other islands were not short of that amount. Much damage was done to plantations, roads, and bridges, owing to the swollen rivers and mountain streams. The trade winds during the month have been very strong, blowing from east to east-northeast, and attended with violent rain squalls and rough sea."

Compared with the corresponding month of previous years the storms of the north Atlantic were deficient in number and energy. The storms traced for June in preceding years have varied in number from three, in 1883, to fourteen, in 1886. Severe storms are unusual in the middle latitudes of the north Atlantic during this month, and those of tropical or subtropical origin seldom acquire destructive strength. Among notable storms for June may be mentioned those of the first decade of that month in 1885, one of which advanced eastward over Nova Scotia and Cape Breton Island during the 1st and 2d, causing considerable damage to shipping and other property. The other passed eastward from the New Jersey coast during the 5th, and thence eastward to the Grand Banks by the 7th. This storm was especially severe along the Newfoundland coast, and was considered the most disastrous that had visited the island in forty years. It was estimated that more than fifty vessels were totally wrecked, while a large number were driven ashore and seriously damaged.

The following are brief descriptions of the depressions traced for June, 1889:

1.—This depression was central in about N. 56°, W. 24°, on the 1st, with central pressure about 29.00 (736), and fresh and strong north to west gales to the fortieth meridian. By noon, Greenwich time, of the 2d the depression had apparently changed its position but slightly. By the 3d it had moved southward to about N. 51°, W. 20°, from which position it recurved northward to the fifty-sixth parallel by the 4th, after which it disappeared beyond the region of observation. This depression showed the lowest barometric pressure, and occasioned the strongest gales of the month.

2.—This depression was a continuation of low area iv, and passed eastward from the Gulf of Saint Lawrence over Newfoundland during the 14th, and thence northeastward over the ocean by the 15th, after which it passed north of the region of observation. This storm possessed moderate strength during its passage over Newfoundland, but apparently increased in energy after the 14th.

3.—This depression advanced rapidly northeastward over the Gulf of Saint Lawrence and Newfoundland during the 17th, with pressure below 29.70 (754), and on the morning of the 18th was central in about N. 55°, W. 45°, after which it disappeared north of the region of observation with an apparent increase in energy.

4.—This depression was a continuation of low area vi, and advanced eastward over the Gulf of Saint Lawrence during the 20th, with pressure below 29.40 (747), and fresh gales along the American coast. On the morning of the 21st the depression was central north of Newfoundland, attended by fresh to strong gales over the Grand Banks; by the following